higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

APRIL EXAMINATION

ELECTRO-TECHNOLOGY N3

5 APRIL 2016

This marking guideline consists of 11 pages.

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QUESTION 1

1.1 1.1.1 Yoke ✓ (2)
1.1.2 Pole shoes ✓ (2)

1.2 1.2.1
- By moving brushes backwards in the motor. ✓
- By moving brushes forwards in the generator. ✓ (2)

1.2.2
- Interpoles are smaller poles placed between the main poles. ✓
- Connected in series with the armature and must have the same polarity as the main poles - passed in the motor – to ensure sparkless commutation. ✓ (2)

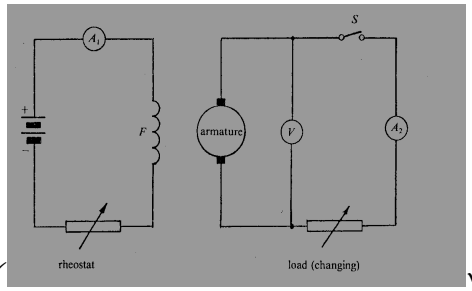
1.2.3
- By making use of series winding on the main field poles. ✓
- Varying the main field to the load condition. ✓ (2)

[10]

QUESTION 2

2.1
- The number of pairs of poles used. ✓
- The strength of the magnetic field or flux. ✓
- The rate at which the magnetic flux is cut by the moving conductor. ✓
- The number of active conductors connected in series. ✓ (4)

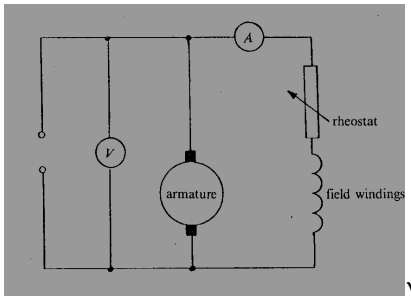
2.2 Separately excited generator. ✓ (1)



✓ ✓

For correct labelled sketch (2)

Self-excited generator ✓ (1)



✓ ✓

For correct labelled sketch (2)

[10]

QUESTION 3

3.1
- Effective field flux is reduced due to armature reaction as the load increases. ✓
- Voltage drop due to the armature circuit resistance. ✓ (2)

3.2 Used as the generator in the Ward-Leonard motor generator system. ✓ (1)

3.3 3.3.1 Shunt generator – it is used where a constant voltage is required. ✓ (1)

3.3.2 Series generator – as a booster on DC transmission line. ✓ (1)

3.4
- Flux (Φ) ✓
- Armature current (Ia) ✓ (2)

3.5
- Driving crane ✓
- Train ✓
- Hoists ✓
- Lifts
- Trolley buses
- Electric vehicle (Any 3 x 1) (3)

[10]

QUESTION 4

Given: R = 300 mm = 0,3 m; N = 420 r/min; effective load = 425 N.m
V = 0,21 kV = 210 V; I = 33 000 m A = 33A

4.1 Input Power [P] = IV
= 33 A x 210 V✓
= 6 930 W✓
= 6,93 kW✓ ⟶ Answer (3)

4.2 Output Power [P] = $\frac{2\ x\ \Pi NWr}{60}$
= $\frac{2 \times 3{,}142 \times 420 \times 425 \times 0{,}3}{60}$ ✓✓
= 5608,47 W✓
= 5,609 kW ✓Answer ⟶ (4)

4.3 Efficiency = $\frac{Output}{Input} \times 100\%$
= $\frac{5{,}609\ kW}{6{,}93\ kW} \times 100\%$ ✓
= 0, 80938 x 100%✓
= 80,938 % ✓ ⟶ Answer (3)
[10]

QUESTION 5

Given: :- e_1 = 20 V; e_2 = 42 V; e_3 = 83 V; e_4 = 120 V; e_5 = 95 V; e_6 = 35 V; e_7 = 18 V.

5.1 5.1.1 Alternating voltage. ✓ (1)

5.1.2 Actual [E_{RMS}] = $\sqrt{\frac{e_1^2+e_2^2+e_3^2+e_4^2+e_5^2+e_6^2+e_7^2}{n}}$

= $\sqrt{\frac{20^2+42^2+83^2+120^2+95^2+35^2+18^2}{7}}$ ✓

= $\sqrt{\frac{34\,027}{7}}$ ✓

= $\sqrt{4\,861}$

= 69.721 V✓ ⟶ Answer (3)

5.1.3 Average Value [E_{AVE}] = $e_1+e_2+e_3+e_4+e_5+e_6+e_7 \,/\, 7$

= $(20+42+83+120+95+35+18)/7$ ✓

= $413/7$ ✓

= 59 V✓ ⟶ Answer (3)

5.1.4 Form factor= E_{RMS}/E_{AVE} = $69{,}721V/59V$

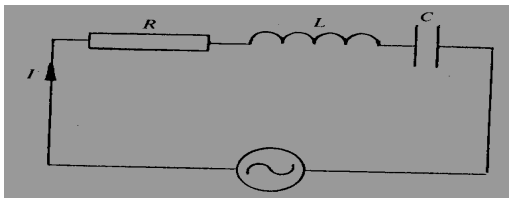
= 1,182 ⟶ Answer ✓ (1)

5.1.5
- Sine wave ✓
- Peak wave
- Sinusoidal wave (Any 1 x 1) (1)

5.2 Maximum value – is the maximum or peak value of an alternating voltage or current. ✓ (1)

[10]

QUESTION 6



6.1 $X_L = 2\Pi fL$ $X_C = \frac{1}{2\Pi fC}$

= 2 x 3,142 x 60 Hz x 400 x 10^{-3} = $\frac{1}{2 \times 3{,}142 \times 60 \times 50 \times 10^{-6}}$

= 150,816 Ω✓ ⟶ Answer = 53,045 Ω ✓ Answer⟶

Impedance of the circuit [Z] = $\sqrt{R^2 + (X_L - X_C)^2}$

= $\sqrt{10^2 + (150{,}816 - 53{,}045)^2}$ ✓

= $\sqrt{100 + 9559.168}$ ✓

= 98,281 Ω✓ ⟶ Answer (5)

6.2 Circuit current [I_t] = $\frac{V_t}{Z}$

= $\frac{240V}{98{,}281\Omega}$ ✓

= 2,442 A ✓ ⟶ Answer (2)

6.3 Phase angle: Tan θ = $\frac{X_L - X_C}{R}$

= $\frac{150{,}816 - 53{,}045}{10}$ ✓

θ = Tan^{-1} 9,777✓

= 84,160º lagging✓ ⟶ Answer (3)

[10]

QUESTION 7

7.1
- With a star connection two voltages are available, namely V_L and V_{ph}.✓
- By earthing the neutral, earth leakage protection is simplified. ✓ (2)

7.2 7.2.1 V_L = 380 V ✓. (Given) (1)

7.2.2 $V_L = \sqrt{3}V_{PH}$

$V_{ph} = \frac{380\ V}{\sqrt{3}}$ ✓

= 219,393 V✓ ⟶ Answer (2)

7.2.3 Input power = $\frac{Output}{\eta} \times 100$

$= \frac{25\ 000}{85} \times 100$ ✓

= 29 411,765 W ✓ ⟶ Answer

Pin = $\sqrt{3} \times V_L \times I_L \times Cos\theta$

$I_L = \frac{29\ 411{,}765\ W}{\sqrt{3} \times 380 \times 0.8}$ ✓

= 55,858 A ⟶ Answer ✓

Therefore $I_C = I_{ph}$ (In star connection)

I_{ph} = 55.858 A ✓ ⟶ Answer (5)

[10]

QUESTION 8

8.1 Pink ✓ (1)

8.2
- Winding ✓
- Core ✓ (2)

8.3 8.3.1

Primary number of turns[N_1] = $42 \times \frac{210V}{70V}$ ✓

= 126 turns ✓ ⟶ Answer (2)

8.3.2

$$\frac{V_1}{V_2} = \frac{I_2}{I_1}$$

$$I_2 = \frac{210V \times 0{,}218A}{70V}$$ ✓

= 0,654 A✓ ⟶ Answer (2)

8.3.3 Secondary volt-ampere = VI

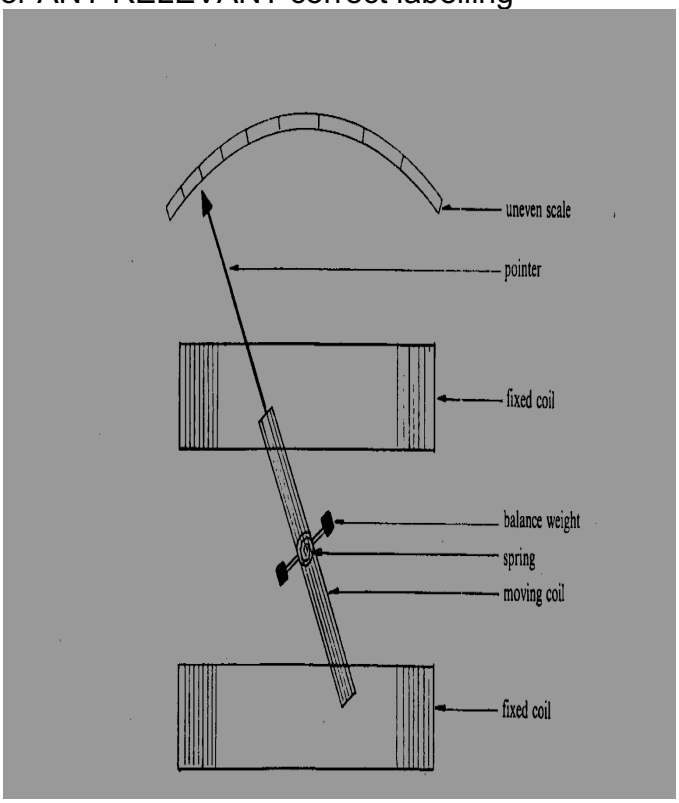
= 70 Volt x 0,654 A

= 45,78 VA✓ ⟶ Answer (1)

[8]

QUESTION 9

9.1 FOUR marks for ANY RELEVANT correct labelling



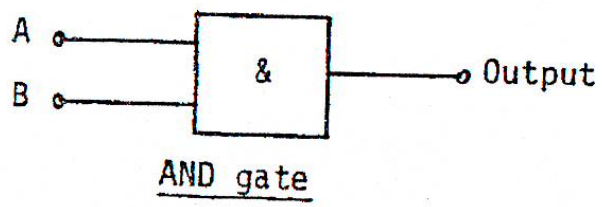
THREE marks for correct sketch. (7)

9.2
- A deflecting device ✓
- A controlling device ✓
- A damping device ✓

(3)
[10]

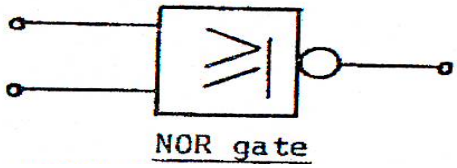
QUESTION 10

10.1 10.1.1



✓✓ for correct diagram and labelling (2)

10.1.2



✓ ✓ for correct diagram and labelling (2)

10.2 10.2.1

2	10
2	5
2	2
2	1

remainder 0 0,5 x 2 = 1
remainder 1
remainder 0 ✓
remainder 1

$10,5_{10} = 1010,1_{2}$ ✓ ⟶ Answer (2)

10.2.2

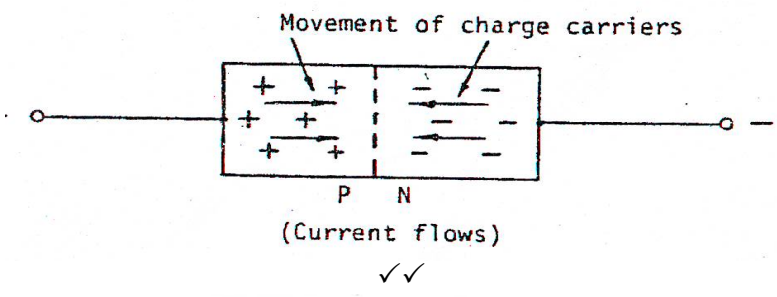
2	14
2	7
2	3
2	1

remainder 0 0,25 x 2 = 0
remainder 1 0,5 x 2 = 1
remainder 1
remainder 1 ✓

$14,25_{10} = 1110,01_{2}$ ✓ ⟶ Answer (2)

10.2.3 -1010,10
1110,01
$0011,11_{2}$ ✓✓ ⟶ Answer (2)

10.3



✓✓

FORWARD BIAS

1 for correct sketch and 1 for labelling (2)
[12]

TOTAL: 100

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